on them. Dr. Harmer's notochord, proboscis-vesicle, and heart are Dr. Masterman's subneural gland, subneural sinus, and preoral sac respectively, and Masterman has demonstrated that the subneural gland of Cephalodiscus and the "Eicheldarm" of Balanoglossus occupy entirely different relationships from the surrounding organs in each case, and therefore cannot be homologous. In both Balanoglossus and Actinotrocha there is a large subneural sinus. The presence of pleurochords in Cephalodiscus, of lateral grooves in Tornaria, and of pharyngeal pleurochords in Rhabdopleura, terminating (as in Tornaria) in oral grooves, which Morgan has shown grow outward into serial pouches, are points of interest in connection with Dr. Masterman's view. Besides, in Balanoglossus there are other chordoid parts in addition to the notochord of Bateson and Harmer. Larval Enteropneusta, again, have a pharynx with simple, paired pleurochords terminating in lateral grooves. It has to be borne in mind that Davidoff describes the notochords and nervous system in certain Tunicates as arising from paired rudiments, and the same observation has been made by Brooks in Salpa. In any case, as Masterman shows, Roule's view that Actinotrocha is a trochophore cannot be held, since the cavity of the latter is a hæmocele, whereas the hæmocele of Actinotrocha is restricted to a small space between the cœlomic sacs. The whole subject is a complex one, yet it may be that further research will weld these diverse views into harmony. Meanwhile, Masterman's opinions have much in their favour.

The memoir concludes with a useful synopsis of the species of Cephalodiscus, and the five plates are excellently drawn and lithographed, the map at the end showing at a glance the distribution of the various species, the whole forming a worthy tribute to the methodical and patient industry of the author, who, along with Dr. Harmer, of the same great museum, has done so much to extend our knowledge of this very remarkable group. W. C. M.

THE ITHACA AGRICULTURAL EXPERIMENTAL STATION.[1]

AGRICULTURAL experts visiting the United States always include the Ithaca Experimental Station in their programme if they can possibly manage to do so, for it is one of the finest and largest in that country of large institutions. Incidentally also, it appeals to all who read and loved Fenimore Cooper in their younger days, for it is situated in the lake country, and still preserves some of the waterfalls and woods associated with his heroic, if somewhat mythical, warriors.

The reports before us are bulky volumes, each of a thousand or twelve hundred pages; they are in keeping in point of size with the whole institution. The list of the staff occupies four closely printed pages, and includes nearly two hundred names. The number of printed copies of bulletins, reports, etc., sent out during one year only was 3,014,000. The State grant was 450,000 dollars in 1913; it rose during the war to 779,401 dollars for the year 1917–18. An Englishman reading these figures, and realising how greatly the income of this one institution exceeds that of all English agricultural colleges and experimental stations put together, begins to gasp when he finds the acting Dean declaring:—"The greatest single need of the college at the present time is more funds for research"; and again, "In common with other colleges in the University, the College of Agriculture is suffering because of the inadequate salaries which members of the staff are receiving."

The investigations cover the whole field of agriculture, but as no summaries are given it is not easy to find one's way through them.

A large number of the bulletins deal with diseases and pests of farm and garden crops, devoting special attention to practical methods of coping with them. In this type of work the American investigator excels; we have scarcely begun to make provision for field-work in plant pathology in Great Britain, although a promising start has been made with the more fundamental investigations. An extended series of observations on the nodule organism (*Bacillus radicicola*) of soybean is given in Bull. 386; the general result is that nodule formation can be considerably checked or stimulated by the presence or absence of certain salts and by variations in the amount of soil-moisture. Chlorides, phosphates, calcium salts, and certain organic compounds such as sugars, starch, oxalic, lactic, and citric acids, increase the amount of nodule formation; increases in moisture-content had a notable effect also. On the other hand, nitrates, ammonia compounds, and sulphates reduce it, though they do not kill the organism.

The direct assimilation of certain carbohydrates by green plants is discussed in Memoir 9 (1916). Saccharose, glucose, maltose, and fructose are directly absorbed and utilised by plants (green maize, Canada field pea, timothy, radish, vetch, etc.); moreover, they produce a characteristic branched-root system. It is suggested that the absorbed sugar is largely utilised in the root itself, but little migrating to the stems and leaves; this diminishes the downward migration of the sugar produced by photosynthesis and leads to increased top growth. Certain plants, such as radishes, vetch, and Canada field pea, are able to utilise lactose, although this sugar has not been found in the vegetable kingdom. Curiously enough, however, galactose is toxic to green plants, although it is utilised by various fungi. The bearing of the results on the old question of the source of carbon for plants is obvious, and the author concludes, as Laurent did in 1904, that the organic matter of soil plays a direct part in the nutrition of green plants, and in certain circumstances, notably in glass-house work, this part may be very important.

The soil surveys of Oneida County (Bull. 362) and of Orange County (Bull. 351) are typical of this kind of work as done in America. They form interesting reading, and would be helpful to a young man wishing to settle on the land but uncertain to which part of the country to turn.

Costs of production of farm crops form the subject of an important investigation (Bull. 377, 1916). In 1912 and 1913 the average costs of producing oats per acre in New York State were respectively 23·51 dollars and 22·34 dollars per acre, *i.e.* 4*l.* 18*s.* and 4*l.* 13*s.* respectively. It is interesting to compare these figures with the Rothamsted data, where the cost in 1913 was 6*l.* 4*s.* per acre. In both cases one of the largest single items is labour; in New York State it was 3·60 dollars per acre (15*s.*), at Rothamsted 21*s.* 4*d.* per acre, although the rate of wages paid in New York was double that paid in this country. The New York yield was 33·5 bushels per acre, that at Rothamsted 48 bushels.

Bull. 338 contains an interesting study of fertile and infertile soil otherwise similar in character; it was found that the former more readily accumulated nitrates than the latter. The most obvious cause was the difference in compactness of the soil, the fertile being less compact and having a smaller volume-weight than the less fertile one. An extensive bacteriological

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[1] Reports of the Agricultural Experimental Station, Ithaca, New York, for the Years 1914–17.

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examination was made by H. J. Conn, but it led to no result, indicating the weakness of present-day methods. The bacterial numbers fluctuated with the moisture-content, as at other centres. Some interesting soil-moisture relationships are brought to light in Bull. 352 (1914). E. J. RUSSELL.

THE RAINFALL OF THE UNITED STATES.

PROF. ROBERT DE C. WARD, of Harvard University, contributes an article on "Some Characteristics of the Rainfall of the United States" to the *Scientific Monthly* for September. The article is essentially of a popular character, but it is dealt with in a strictly scientific manner, and references to the several works from which the information is selected are given throughout, so that a closer and more minute study can be made where thought desirable. Many of the characteristics dealt with are among the most important, and certainly the most interesting, associated with rainfall. There is an endeavour to explain the cause of the special characteristics, a feature in many discussions of the present day. It has often been said in the past, with respect to meteorology, that there are bricks enough, but that we now require builders. Those who have been familiar with meteorology for the last half-century note with satisfaction its practical development.

Referring to the annual and monthly rainfall, Prof. Ward associates the varying amounts with the tracks of cyclones and the general pressure distribution which constitute the rain-producing conditions. The ratio of wettest and driest years to the mean fall is given for the United States generally. Where the annual rainfall ranges from 5 in. to 30 in. the fall in the wettest years may be expected to amount to about 180 per cent. of the average, whilst in the driest years the total is not likely to be less than about 55 per cent. of the average. Years with precipitation above the mean are less frequent than years with precipitation below the mean. It is emphasised that it is always instructive to investigate the weather-map conditions in all cases of unusually wet or dry periods, and to follow especially the tracks of low-pressure systems.

Dealing with periods with or without precipitation, the article states that "over most of the country the number of consecutive rainy days has been between 10 and 20. . . . On the north-western coast (Western Oregon), where the rainfall is heavy and the cyclonic activity is marked, more than 30 days in succession (30 to 40) have been rainy. . . ."

It is said that droughts may occur anywhere in the United States, especially where cyclonic controls of precipitation are weak. There is a distinct relation between droughts and forest fires—"a pre-requisite of a forest fire is a drought."

The Government meteorological reports, such as the Annual Report of the Chief of the Weather Bureau and the Monthly Weather Review, give much valuable material with respect to rainfall. As a rough-and-ready classification of excessive rainfalls, mention is made of 10 in. or more in a month; 2·50 in. or more in twenty-four hours; and 1 in. or more in an hour. Referring to secular variation of rainfall, it is pointed out that trustworthy conclusions cannot be drawn, as few observations go back to 1850, and most observations date from later than 1870. A period of observations for twenty-five years, 1887–1911, for all districts of the United States "lends no colour to the theory of a cycle in precipitation," and curves for New England, the Western Gulf, and North Carolina for 1879–1911 "show no approach to uniformity of distribution in time or space." For non-instrumental evidence a study has been made of the "rings" of trees in Arizona and California, "it being assumed that the thickness of the annual layers of tree-growth gives an approximate measure of the annual amount of precipitation. . . . The fact that the 'big trees' have continued to thrive for three thousand years has been taken to indicate a remarkable uniformity of climatic conditions rather than a series of oscillations."

C. H.

RETIREMENT OF SIR OLIVER LODGE.

ON January 1 the City of Birmingham gave expression to its high appreciation of the work of Sir Oliver Lodge as Principal of the University. At a meeting in the Council House, at which the Lord Mayor (Alderman William Cadbury) presided over a representative gathering of the leading citizens, an illuminated address was presented to Sir Oliver and Lady Lodge. The address, which was read by Sir Gilbert Barling (Vice-Chancellor of the University), was as follows:—"To Sir Oliver Lodge, F.R.S., LL.D., and Lady Lodge: On the eve of your departure from Birmingham we desire to express to you our deep sense of loss, our sincere appreciation of your great services, and our warmest wishes for your happiness and well-being in your new home. To you, Sir Oliver, we owe much as a physicist. Your distinction has added lustre to our city. As academic leader you have started our University on its career with lofty ideals. You have done much to form public opinion as to the meaning of true education in all its forms and among all classes, and your ethical teaching has ever been directed towards social amelioration. You may be satisfied that your labours of nearly twenty years have left a deep and lasting mark on the community which you have so long adorned. To both of you we wish good-bye with the deepest regret, and our most kindly feelings accompany you."

Sir Gilbert added that it was the intention of the subscribers to present also more substantial evidence of their kind feelings in the form of a motor-car, and a jewel for Lady Lodge. He reminded his audience of the greatness of the task which Mr. Joseph Chamberlain had set before the first Principal of the University, and he bore eloquent testimony to the admirable way in which Sir Oliver had realised the ideals of that statesman and justified his choice.

Sir Oliver Lodge in his reply emphasised the debt which the city owed to those public-spirited men who had gone before. He hoped the city had become proud of the University which it had brought into being. It took a little time always to know what an institution was worth, but the University was the crown of the city. He referred to the difficulties under which the University had laboured through lack of funds, but he believed that a better day was dawning. The State and the city were co-operating to a greater extent than before. One of the first uses he proposed to make of his freedom was to visit America. He had often been asked to go, but had never before been free to do so.

THE CHIPPAWA-QUEENSTON HYDRO-ELECTRIC DEVELOPMENT SCHEME.

AMONG the whole of the world's sources of water-power the Niagara Falls stand in a position of unique importance. Not only is the gross capacity of 5,000,000 h.p a magnificent industrial asset of unrivalled proportions, but the actual development of the Falls at the present time has enabled

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